tion, Dr. Arthur Hill Daniels, professor of philosophy, was appointed acting dean. Dean Daniels' appointment is to remain effective until something definite shall be done in regard to the proposed combination of the College of Literature and Arts, and the College of Science.

MR. C. SHEARER, M.A., Clare College, Cambridge, has been appointed university lecturer in zoology.

DR. CONSTANTIN CARATHÉODORY, of the Technical Institute at Breslau, has been appointed professor of mathematics at Göttingen as successor to Professor Felix Klein.

DISCUSSION AND CORRESPONDENCE

RELATIVITY IN ELECTROMAGNETIC INDUCTION

IN SCIENCE of January 17, 1913, S. J. Barnett adduces a certain experiment as constituting an *experimentum crucis* showing that complete relativity does not exist in electromagnetic induction. The experiment is certainly an interesting one, but on closer examination does not seem to be so definitely in contradiction to the principle of relativity as may appear at first sight.

For discussion let us consider the following simple form of experiment which illustrates the same principles. Take a cylindrical magnet magnetized longitudinally and symmetrically about its axis, and mount it in the axis of a somewhat larger cylindrical metal tube, with air or other dielectric between insulating one from the other, and forming a cylindrical condenser. Connect the two by a metal brush or cross-connection reaching radially across from the tube to the middle of the magnet. Now if the whole system considered as rigidly connected is spun around its axis of figure there will of course be induction and a difference of potential established between the magnet and the outer tube, and if the brush connection be broken while the system is in rotation, on bringing the whole to rest the condenser, consisting of tube and magnet, will be found charged.

So also when the tube alone is rotated while the magnet is kept at rest, a difference of potential is established, provided the metal connecting brush rotates with the tube. Or if the magnet is rotated and the tube kept at rest experiment shows the inductive effect to be the same if only the cross-connection rotates with it. And finally if both magnet and tube are kept at rest while the cross-connection alone is rotated about the axis of the system the observed effect is the same.

On the other hand, no inductive action is observed when tube or magnet or both together are rotated so long as the connecting brush is at rest.

The motion of the cross-connection is thus the determining factor, but relative to *what?* Must not any effect *that we can observe* be due to motion *relative to the apparatus and connections by which the inductive action is tested.*

Of course the induction may be conceived as due to motion relative to coordinates fixed in the ether or in space, and the effect would then depend on the direction of the axis of the magnet relative to the earth's axis, and the rotational velocity of the earth, and on its translational velocity in space. But even in that case the inductive action which also takes place on the system by which the effect is tested, in consequence of its motion in space, may be expected to be such that no inductive action could be *observed* except in case of such relative motion as is specified above.

For so long as the cross-connection and the testing apparatus by which the effect is to be observed are at rest relative to each other no change in the magnetic flux through the circuit will be produced by any rotation of the whole system about the axis of the magnet.

It appears therefore that if the testing apparatus rotates about the axis of the magnetic field at the same rate as the cross-connection between magnet and tube, no charge will be found, while if it rotates with an equal angular velocity in the opposite direction the charge found will be twice as great as if it were at rest.

If these statements are in accordance with the experimental facts, as I believe them to be, then such an experiment can afford no infor-

mation touching the motion of the ether in the field around a rotating magnet.

ARTHUR L. KIMBALL

AMHERST COLLEGE,
January 20, 1913

SCIENTIFIC METHOD

TO THE EDITOR OF SCIENCE: Permit me to protest vigorously against the exceedingly narrow conception of scientific method implied in Professor MacDougall's discussion of "neo-vitalism" in your issue of January 17. I am not a defender of neo-vitalism, and have no interest in the controversy between the neo-vitalists and their opponents; but I am interested in keeping the scientific method broad enough to apply to all phases of human experience. It is surely to be deplored that in this age, just when science is expanding to include all human life within its scope, a few scientific men should persist in interpreting scientific method in such a way as to limit its application to purely physical phenomena. If it is true that "natural science rests finally upon the assumption of mechanism [*i. e.*, rigid determination of all processes through the operation of mechanical causes] and excludes all other conceptions," then there can be no scientific treatment of religion, morality or any other phase of the mental and social life of man. Upon this assumption there can only be physical and biological sciences, and we must give up the hope of having mental and social sciences; for the impossibility of demonstrating mechanical causation in the mental and social realms is acknowledged by all careful thinkers and investigators.

Furthermore, the necessity of science assuming the universality of, and the rigid determination by, mechanical causation, is not evident, unless science wishes to transform itself into a system of monistic philosophy. Rather the pragmatic development of science would permit the assumption of one principle of explanation in one realm of phenomena where it works, and of another in another realm, where that works; for science is "a prolongation of common sense." Thus in the physical sciences no other principle than the mechanistic one is invoked, because mechanical cause and effect will work as a principle of explanation. But in a science like economics, for example, there is little use made of mechanical cause and effect as a principle of explanation because it will *not* work. All modern economics, as is well known, is built upon the conception of "value." Now, is economics a science, or not a science? To me the attempt to explain economic phenomena through mechanics is as absurd as the attempt to explain biologic phenomena through "entelechy." In either case it is the attempt to explain the known through the less known. The case is exactly similar with all the other social sciences. It may be replied that economics and the other social sciences are "sciences," but not "natural sciences." This reply, however, does not meet the issue, because no one can separate the natural sciences from other positive sciences unless the word "natural" be defined to mean the physical.

I am uncertain as to the purpose of Dr. MacDougall's argument, as to whether he wishes to limit greatly the scope of science (as do some philosophers), or to carry through the mechanistic conception as a universal principle of explanation (as do some scientists). In either case the argument practically denies the possibility of positive sciences of our mental and social life. To many people this is, of course, a welcome conclusion. But the whole development of modern science is against this conclusion. The extension of scientific methods to the mental and social realms of phenomena in the nineteenth century, without any use of mechanistic assumptions, was accompanied by as substantial triumphs in those realms as science has had anywhere. Is it not time to acknowledge this? It will not do to say that the assumption in all cases where science has made substantial advances in explaining mental and social phenomena has been that of mechanism; on the contrary, the mechanistic assumption, when brought in at all, has been brought in as a metaphysical "guess" which really explained